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THESIS

THE SEQUENTIAL SELF-SELECTION AUCTION
MECHANISM FOR SELECTIVE REENLISTMENT BONUSES:
POTENTIAL COST SAVINGS TO THE U.S. MARINE
CORPS

by

Paul B. Bock

June 2007

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This thesis explores the potential cost savings for the Marine Corps by replacing the current SRB program with one that uses the format of a Sequential Self-Selection Auction Mechanism (S^3AM). The power of predicting behavior based upon opportunity costs is the theoretical underpinning of the Sequential Self-Selection Auction Mechanism (S^3AM). The S^3AM greatly reduces the payment of economic rent. The payment of economic rent is limited because the Marine Corps would only pay Marines a monetary sum that more closely corresponds to their active duty opportunity cost. In other words, the S^3AM would allow the Marine Corps to capture more of the economic surplus, making the SRB process substantially more cost effective.

If a S^3AM were used in lieu of the current SRB program, the Marine Corps would potentially save money while still meeting endstrength requirements. For example, using the S^3AM in FY 2006 would have potentially saved the Marine Corps $12,123,885, $690,471 and $118,390, respectively, for the three Military Occupational Specialties (MOSs) analyzed, based on a four year multiple. This savings would have been realized, if the two and six year S^3AM model were used to pay FY 2006 bonuses to the 0311s, 0621s and 5811s that reenlisted.

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**THE SEQUENTIAL SELF-SELECTION AUCTION MECHANISM FOR
SELECTIVE REENLISTMENT BONUSES: POTENTIAL COST SAVINGS TO
THE U.S. MARINE CORPS**

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I. INTRODUCTION

A. PURPOSE AND OBJECTIVES

Selective Reenlistment Bonuses (SRBs) are an influential tool that United States Marine Corps manpower planners use to appropriately shape the force, while simultaneously ensuring that endstrength requirements are met. The principal purpose of SRBs is to attract well-qualified service members and persuade them to reenlist for a specified period of time. Offering a financial incentive enables the Marine Corps to meet its enlisted endstrength goals, while rewarding each eligible Marine with premium compensation. However, SRBs can be costly and money only comes in finite quantities. As with other fiscal funding, the capital that supports the Marine Corps' SRB program must be appropriated through the United States Congress on an annual basis.

The Global War on Terrorism has significantly heightened the costs associated with the SRB program. As a result, the Marine Corps' authorized endstrength has been notably increased. This endstrength increase obviously incurs a greater cost that must be appropriated and paid to qualified Marines. Major Jerry R. Morgan, the U.S. Marine Corps' Enlisted Career Force Planner, has said: "The Marine Corps has almost doubled its SRB cost in just one year, spent approximately $53M in FY05, but will spend approximately $92M in FY06."[1]

B.   RESEARCH QUESTIONS

This thesis seeks to evaluate whether the current SRB program can be replaced by a Sequential Self-Selecting Auction Mechanism $(S^3AM)^2$ for improved effectiveness and cost savings. Ultimately, this thesis will ascertain which option would generate the most cost savings to the Marine Corps.

1.   Primary Question

Most specifically, the primary objective of this thesis is to explore the potential cost savings for the Marine Corps by replacing the current SRB program with one that uses the format of the S^3AM. The methodology relies heavily on previous research reported in scholarly articles and journals, as well as the construction of cost curves to estimate the potential savings to the Marine Corps.

2.   Secondary Question

Second, this thesis will determine the feasibility of substituting the S^3AM in lieu of the current SRB program.

C.   PAY AND THE COST EFFECTIVENESS OF THE ALL-VOLUNTEER FORCE

A cursory look at the military pay system and the efficiency of the all-volunteer force is useful because it illustrates a Department of Defense policy that is more cost effective, than the Marine Corps' current SRB program. Pay is one of the many notable differences between the Armed Forces and civilian companies. It is also one topic that seems to garner significant media attention and scrutiny.

Members of the Armed Forces are paid according to their current rank and their time within their respective service. Thus, a service member's pay is calculated from a rigid and inflexible pay chart. However, there is a clear incentive for promotion which boosts short-term pay and long-term retirement pay.

The Department of Defense's pay chart does not allow leaders to reward the deserving, but does allow them to punish the wayward through loss of rank. As Cymrot and Mayberry observe, the system lacks flexibility:

> The only targeted flexibility within the system comes through special pays, such as Aviation Continuation Pay or Selective Reenlistment Bonuses. Under the military pay, personnel have little control over their own financial circumstances.[3]

Special pays are very rarely adjusted for inflation and are still well below comparable civilian bonuses. Secondly, the salaries that are paid to service members must be appropriated through the Congressional budgetary process. Civilian companies are not required to submit budget proposals through the House of Representatives, nor are they required to strictly adhere to a Department of Defense pay chart. The pay outlays for the Armed Forces are immense and come from public tax dollars, which also does not occur within civilian corporations. For example, in 2001, President Bush "proposed a $5.7 billion increase in the amount to be spent on compensation and benefits."[4]

The expense of maintaining the all-volunteer force has not abated and now "costs twice as much to maintain a person in uniform in the all-volunteer force than it did during the

days of conscription."[5] Even though the costs of
maintaining the all-volunteer force have steadily increased,
the overall cost to society has decreased. For instance,
the personnel cost of the Armed Forces as a percentage of
Gross Domestic Product (GDP) in 1975 was two percent; in
2000 it was less than one percent of GDP.[6]

Additionally, from an economic standpoint, the all-
volunteer force is more efficient "due to the fact that the
opportunity costs of the personnel comprising a volunteer
force will always be less than or equal to the opportunity
costs of the personnel serving in a mixed force of equal
size."[7] However, there are exceptions, such as involuntary
service. Involuntary service is less efficient because
society bears more of the burden and pays more of the cost.
This occurs because those who were involuntarily called into
service typically had higher opportunity costs than those
who volunteered. Society must then pay the difference in
opportunity costs. Clearly, the all-volunteer force
benefits both society and the military. Society experiences
less of a deadweight loss and is consequently more
economically efficient; at the same time, an all-volunteer
system provides the Armed Forces with motivated enlistees
and officers.

The all-volunteer force continues to perform admirably
and has done remarkably well during recent and continuing
combat operations in Iraq and Afghanistan. The patriotic
fervor that occurred after September 11, 2001 has abated,
but the services are still able to attract the quantity and
quality of enlistees and officers that their respective
labor pools demand, with the obvious exception of the Army.

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Additionally, people are staying in the services longer and are coming in slightly older than they were 30 years ago.[8] John Warner and Beth Asch, in their article "The Record and Prospects of the All-Volunteer Military in the United States," have written:

> In other words, the average recruit today has stayed about two years longer than did the average recruit during conscription. The average age of the enlisted force has risen from 25 years to 27.5 years. Between 1974 and 1987, "careerists," personnel with more than four years of experience rose from 39 percent to 50 percent of the enlisted force.[9]

As the force has aged and become more experienced, it has also become more productive and efficient, particularly with respect to occupational specialties. However, as the force has aged, many service members are getting married at younger ages when compared with their civilian counterparts. As Charles Moskos has observed "married junior enlisted personnel have become an accepted reality, a trend with major budgetary implications with regard to housing and medical care."[10]

Additionally, recent combat operations have required excessive deployments for many service members. These deployments have required them to part from their families on numerous occasions. Because of these frequent and long separations, some service members have begun to opt out of the military, to seek the security and solace of stable civilian employment. In this respect, the security of a non-deployable civilian job becomes the more favorable option. A new civilian career may also offer more choice regarding salary, location, position, schooling, community,

and so on. As evidenced from the aforementioned paragraphs, the all-volunteer force portrays to the reader a cost effective DOD policy, which serves as a useful guide in helping to transform the Marine Corps' SRB program.

D.   CURRENT SELECTIVE REENLISTMENT BONUS POLICY

The Marine Corps Order on SRBs describes the program in the following way:

> The SRB program was established to assist in attaining and sustaining adequate numbers of career enlisted personnel in designated Military Occupational Specialties (MOS's) and within particular years-of-service groupings. The program provides a monetary incentive for a reenlistment of at least 4 years at three career decision points during the first 14 years of service. Marine Corps Bulletin 7220 series, published separately and revised as required to meet the needs of the Marine Corps, identify MOS's eligible for a SRB and their multiples. The intent of this program is that Marines who receive a bonus for reenlistment in a particular skill serve the entire period of reenlistment in that skill.[11]

Typically the Marine Corps Bulletin, which is referred to in the aforementioned paragraph, is published annually. The Marine Corps Bulletin lists the jobs (MOSs) that are eligible for SRBs and the multiples in which they will be paid for meeting the specified criteria and formally agreeing to remain in service for a particular length of time. Additionally, the bulletin lists the MOSs that will be paid an SRB in each particular zone. The three zones available for reenlistment are: Zone A, Zone B, and Zone C. Zone A reenlistments are for Marines who have served on active duty for a period between 21 months and six years.[12]

Zone B reenlistments are for Marines who have served on active duty for a period of six to ten years.[13] Zone C reenlistments are for Marines who have served on active duty for a period of 10 to 14 years.[14] The reenlistment zones are a subset to the Marine Corps' First-Term Alignment Plan (FTAP) and the Subsequent-Term Alignment Plan (STAP). According to Major Jerry R. Morgan, the FTAP accomplishes the following:

> ➢ Identifies the number of first term eligible Marines, by Primary MOS (PMOS), who are needed to meet endstrength requirements.[15]
>
> ➢ Reenlistment allocations are based on endstrength requirements and projected inventory surpluses.[16]
>
> ➢ "Prevents promotion stagnation."[17]
>
> ➢ "Fills undermanned MOSs through the lateral move program."[18]

The primary purpose of the STAP "is to move Career Force inventory levels toward Career Force requirements when an imbalance is present."[19] The Career Force consists of Marines who have served their initial enlistment and who have reenlisted for a second time. This process is highly competitive; indeed, "over the past six years, the reenlistment opportunity for the Corps has been around 25%."[20] According to Major Jerry R. Morgan, the STAP is designed to achieve the following:

> ➢ Retains Marines to meet the endstrength requirements of the Career Force.[21]
>
> ➢ "Complements the FTAP by reducing first-term reenlistment requirements."[22]
>
> ➢ Identifies short MOSs that must be filled in order to meet endstrength requirements of the Career Force.[23]

The money to be paid out as an SRB is computed in the following manner:

> The bonus amount is computed by multiplying: (1) The Marine's monthly basic pay at the time of discharge or release from active duty; (2) Times the number of years, and/or fraction of years (months) of additional service for which the Marine will be obligated beyond existing obligated service; (3) Times the SRB Program multiple, not to exceed 10, for the applicable MOS as designated in the current Marine Corps Bulletin 7220 series.[24]

The total SRB amount that is paid to an eligible Marine may not exceed $90,000 and that Marine must reenlist for a period of three or more years.[25] Ultimately, the FTAP "plans for the future"[26] and the STAP balances out the Career Force endstrength requirements using SRB payments. Although the SRB payments are not cost effective due to the payment of economic rents; the SRB program adequately ensures that enlisted endstrength requirements are met.

E.   SUMMARY

Analyses of pay and the all-volunteer force are important because they illustrate a cost effective Department of Defense policy. The Sequential Self-Selecting Auction Mechanism (S^3AM) would limit the payment of economic rent. Economic rent would be limited, because the Marine Corps would pay Marines a monetary sum that corresponded more closely to their opportunity cost of remaining on active duty. In other words, the S^3AM would allow the Marine Corps to capture more of the economic surplus, making the SRB process more cost effective.

Ultimately, if a S^3AM were used in lieu of the current SRB program, the Marine Corps would save money and still meet endstrength requirements.

Consider that Marines who are eligible for the SRB program roughly fall into the following three categories:

1. Marines who would be willing to reenlist for only a fraction of the SRB amount, or none at all.
2. Marines who would be willing to reenlist for the exact SRB amount.
3. Marines who would be willing to reenlist, but only for an amount which is higher than the SRB being offered.

Marines who have been assigned to the MOSs that qualify for an SRB, and who then reenlist, will almost exclusively come from category 1 above; therefore they receive economic rents. A Sequential Self-Selection Auction Mechanism (S^3AM) would limit the payment of economic rent, because the Marine Corps would provide Marines a monetary sum that coincides more closely with their willingness to accept a reenlistment, or which more closely reflects their willingness to stay. In other words, the S^3AM would allow the Marine Corps to capture more of the surplus, making the SRB process more cost effective. Ultimately, if a S^3AM were used in lieu of the current SRB program, the Marine Corps could save a substantial amount of money and still have a high caliber of reenlistees.

F.   THESIS CHAPTER OVERVIEW

This thesis will be arranged into five chapters. Chapter I, the introduction, will provide background information to the reader and delineate the structure of the thesis. Chapter II will cover topics such as: the four

types of auctions, the basics of auction theory, asymmetric
information, and signaling. Chapter III, the literature
review, will discuss a variety of published works that are
pertinent in building the case for an overhaul of the Marine
Corps' current SRB policy. Chapter IV will discuss the
theoretical approach toward the implementation of the S^3AM
for the Marine Corps' SRB program. Additionally, chapter IV
will present graphic depictions of the potential cost
savings that may be generated through the implementation of
the S^3AM. Lastly, Chapter V will present the summary,
conclusions, and recommendations for further study.

II. AUCTIONS, ASYMMETRIC INFORMATION, AND SIGNALING

A. CHAPTER INTRODUCTION

Auctions are not new, nor are they unique. They have been used in the marketplace for thousands of years to sell items such as fine wine, stamps, art, produce, and countless other items. This chapter serves two purposes. The first purpose is to summarize the basic types of auctions. The second purpose is to discuss the importance of signaling and asymmetric information in auctions.

B. THE BASIC AUCTIONS

1. The English Auction

The English auction has been used for centuries. It has been used by "Sotheby's since 1744 and Christie's since 1766," to sell items such as fine art, furniture, clothes worn by former First Ladies, and many other unique items.[27] eBay has become the modern purveyor of English auctions and has turned this auction type into a lucrative business. For instance, eBay averages 750,000 daily transactions, which amount to the daily exchange of $30 million.[28] Campbell has succinctly described the English auction as:

> The bidders interact directly with each other, in stages. Someone makes an initial bid, and anyone can raise it. This process continues until no one is willing to raise the bid. The asset goes to the last bidder at a price equal to his or her bid.[29]

An English auction typically uses an oral/outcry format, such as that used by Sotheby's and Christie's.

2. The Dutch Auction

Dutch auctions are often used to sell agriculture items, such as roses. Additionally, a Dutch auction may also be referred to as a descending bid auction, because the product ask price steadily declines over time. A Dutch auction "is the converse of an English auction."[30] Milgrom has described the Dutch auction as: "the auctioneer/seller begins by asking a high price and gradually lowers the price until some bidder shouts "Mine" to claim the item."[31] Some Dutch auctions have visible timers and bid displays that record the current time and the current bid. As the auction progresses, the ask price descends until a bidder has gone at or below their reservation value, which is dependant upon the number of bidders and the distribution of their bids. Subsequently, the bidder will submit or announce a bid that is at or below their reservation price, which stops the clock and awards the product to the highest bidder.

3. The First-Price Sealed-Bid Auction

First price auctions may be used for items such as: mineral rights, government contracts, artwork and real estate.[32] Many people refer to this type of auction as a "silent auction," because bids are submitted in writing and there is no auctioneer calling out prices and bids. Typically, most first-price sealed-bid auctions only allow bidders to submit one bid per product. The product is then

awarded to the individual with the highest sealed-bid.
McAfee and McMillan, describe the first-price sealed-bid
auction in the following way:

> With the first-price sealed-bid auction,
> potential buyers submit sealed bids and the
> highest bidder is awarded the item for the price
> he bid. The basic difference between the first-
> price sealed-bid auction and the English auction
> is that, with the English auction, bidders are
> able to observe their rival's bids and
> accordingly, if they choose revise their own
> bids; with the sealed-bid auction, each bidder
> can submit only one bid.[33]

The first-price sealed-bid auction hinders individuals
from gathering information about the bidding behavior of
others, in striking contrast to the English auction. The
English auction facilitates the observation of other
bidders, which enables individual bidders to reformulate
their bids, based upon their new reservation value for the
product. The optimal bidding strategy in a first-price
sealed-bid auction is for an individual to bid some
increment below his true reservation price for the object,
with the size of this increment depending upon the number of
bidders and the estimated distribution of reservation
values. The bid represents a tradeoff between maximizing
the probability of winning the item (lower bid) and
capturing surplus value if successful (higher bid).

4.   The Second-Price Sealed-Bid Auction

The second-price sealed-bid auction is commonly
referred to as the "Vickrey auction," due to William
Vickrey's epic work in second-price auctions. Essentially,
the second-price sealed-bid auction works identically to the

first-price sealed-bid auction, with one monumental
exception. In the second-price sealed-bid auction, the
bidder with the highest bid wins the product, but will pay a
price equal to the second highest (or first excluded) bid.
Campbell describes the second-price sealed-bid auction in
the following manner:

> Each individual submits one bid, usually without
> knowing what anyone else has bid. The asset is
> awarded to the high bidder at a price equal to
> the second highest bid.[34]

The second-price sealed-bid auction is unique because it
"induces truthful revelation of an individual's reservation
value."[35] Unlike the first-price sealed-bid auction,
bidders in a second-price sealed-bid auction should submit a
bid exactly equal to their true reservation value. Figure 1
clearly illustrates the different types of auctions.

Auction Characteristics

Forward	Reverse

Open / Sequential Bid

English

Dutch

Sealed / Simultaneous Bid

First Price

Second Price
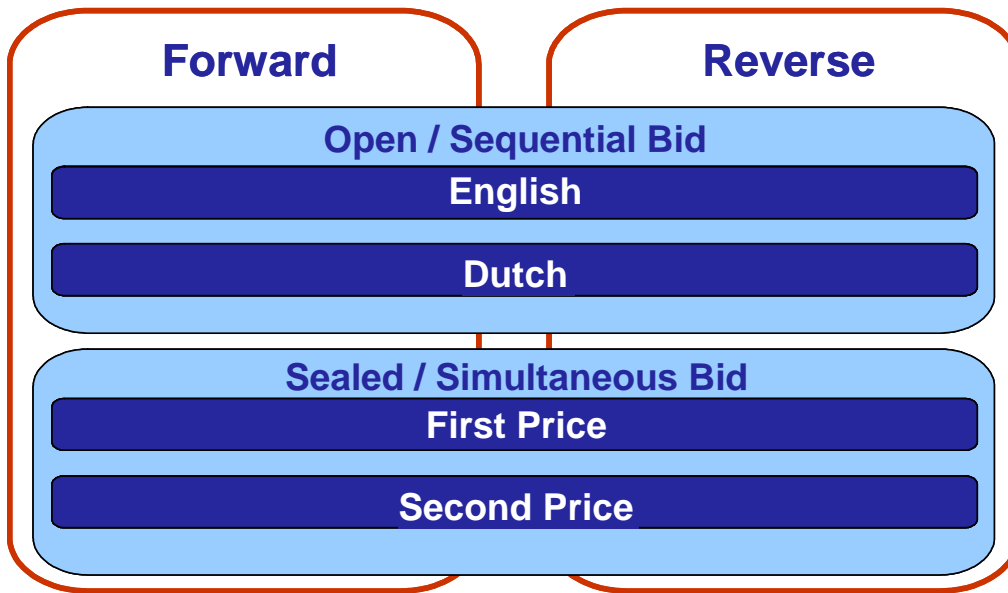
Figure 1.   Auction Types and Their Characteristics[36]

5.   **Forward Auctions and Reverse Auctions**

A forward auction occurs when there is one seller and multiple buyers. A reverse auction occurs when there is one buyer and multiple sellers. In the case of this thesis, the S^3AM is a reverse auction because the Marine Corps functions as a single buyer, buying multiple reenlistments contracts from several Marines interested in selling their employment services. Figure 2 graphically illustrates the aforementioned points.

Auction = Exchange Mechanism
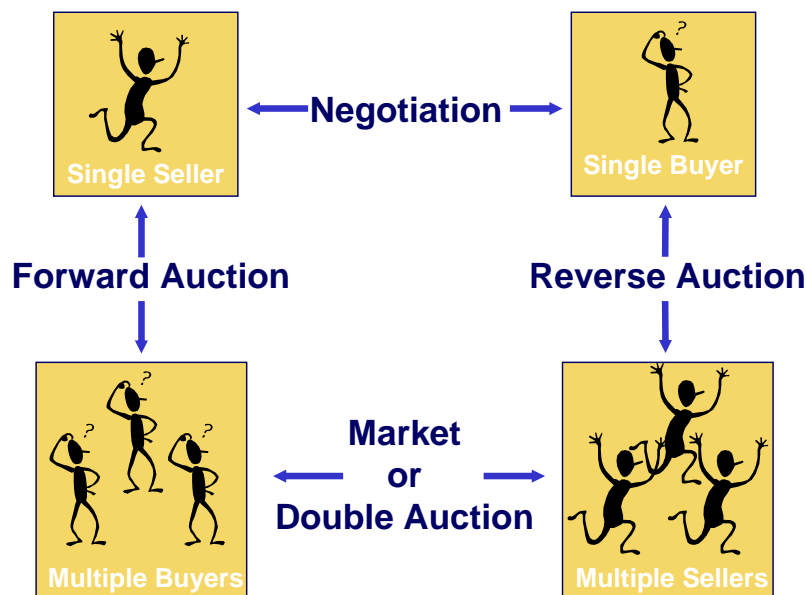
Figure 2.   Forward and Reverse Auction[37]

C.   ASYMMETRIC INFORMATION

Information asymmetry occurs when one party has more information than another party, which may give them an advantage over the other. Specifically, information asymmetry is "a difference in access to relevant knowledge."[38] There are two distinct problems that may occur when information asymmetry is present: moral hazard and adverse selection.[39]

The moral hazard problem stems from the typical principal/agent relationship, an example of this may be found in the labor market. In the typical labor market, the employer acts as the principal and the employee acts as the

agent.   The moral hazard occurs when workers may be tempted to shirk their duties because the employer is not closely observing their behavior.[40]

Adverse selection occurs when one party is privy to more information than another party, such as in the market for used cars.   Mankiw, in his book, "The Principles of Economics," defines adverse selection as: "the tendency for the mix of unobserved attributes to become undesirable from the standpoint of the uninformed party."[41]   For example, if an individual were shopping for a used car and the used car had significant engine problems, unbeknownst to the buyer; the average consumer would deem this transaction as "undesirable."

A classic example of self selection is the market for company health insurance policies.   For example, Company X offers two health insurance polices: a premium policy and a traditional policy.   The premium policy requires the employee to pay a high premium, which ensures that the employee will receive more health benefits and additional health packages, such as a prescription plan.   The traditional plan is low cost and low benefit without any of the additional health packages.   The self selection occurs when relatively sick people, or those with more of a medical need, choose the premium plan, and those with less of a need choose the traditional plan.

D.   SIGNALING

Signaling is the "action taken by an informed party to reveal private information to an uninformed party."[42]
For example, the Marine Corps motto, "First to Fight," sends

two different signals. One, it informs the citizens of the United States that the Marine Corps is always one of the first branches of the Armed Forces to be sent into battle. Secondly, it reminds the Marines that they must always be prepared for combat and rapid deployment.

Two items must be present to create an effective signal: the signal must be costly for the producer and the signal should be beneficial to the consumer of a high quality product.[43] For instance, Sears advertises that their Craftsmen tools are guaranteed for a lifetime, with some minor stipulations. If the tool breaks, the consumer may return the broken item to Sears for a replacement. Sears has sent a signal to consumers, implying that their tools will last forever. This is an effective signal for two reasons. One, Sears has convinced the consumer that they have purchased a high quality product. Two, Sears incurs the costs of advertisement and the replacement costs for broken tools.

The growing market for college degrees offers the following two unique insights: education may be viewed as a tool that signals an individual's ability or may be viewed as a productivity enhancing experience. Proponents of the human capital theory believe that college educated individuals are more productive than their non-college educated counterparts, and are therefore paid a wage premium.

However, other economic theorists believe college graduates signal that they have more ability than a non-college graduate. This occurs for three reasons: individuals who attend college self-select into schools

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based upon their intellectual ability; college is difficult and therefore signals to others the commitment level of that individual; and college is easier for those who are smarter. Employers view this as a signal because "an action is being taken not for its intrinsic benefit but because the willingness to take that action conveys private information to someone observing it."[44]

The previous discussions of asymmetrical information and signaling are vitally important to auction theory. These concepts are important because when moral hazard and adverse selection occur, "the market may fail to put resources to their best use."[45] Auctions are a useful market tool for two reasons. First, when holding all other things constant, auctions allocate goods according to an individual's reservation value. Secondly, auctions force individuals to make cost effective decisions based upon their opportunity costs.

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III. LITERATURE REVIEW

A.   CHAPTER OVERVIEW

This chapter presents published, scholarly articles that focus on the following two areas: auction theory principles and key assumptions, and the presentation of empirical data from experimental auction studies. Specifically, this chapter will be divided into two main parts. The first half of the chapter will present auction theory literature that specifically addresses the theoretical applications behind auctions and their affiliated theories/assumptions. The second half of the chapter will present the published results of empirical studies that have been previously conducted. The empirical studies will furnish the reader with explicit examples of producer surplus, which may be directly correlated to the use of auction mechanisms. Finally, as many of the articles share mutual auction theory concepts, only the unique aspects of each article will be presented in this chapter.

B.   AUCTION THEORY

1.   William Vickrey

In 1996, William Vickrey was awarded the Nobel Prize in Economics: "William Vickrey's research has concerned the properties of different types of auctions, and how they can best be designed so as to generate economic efficiency."[46] William Vickrey's seminal work entitled, "Counterspeculation, Auctions, and Competitive Sealed Tenders," is a treasure trove of auction theory information.

Furthermore, Vickrey's article provides fundamental conclusions that support the purpose of this thesis and lend weight to the arguments.

Vickrey begins his article by addressing the "exclusive public marketing agency." In this section, Vickrey states, "an exclusive public marketing agency to which all sales of this commodity must be made and from which all supplies of the commodity must be bought."[47] In other words, the producer is a monopolistic firm. In the context of this thesis, the Marine Corps may be viewed as a monopolist because no one else may replicate their product or their core competencies (more accurately, the Marine Corps is a "monopolist" or the only buyer in the market for Marine reenlistees). Additionally, Vickrey emphasizes that, "in order to determine the optimum pattern of transactions" the producer must plot their marginal cost curves and determine the utility function of the consumers, or plot their marginal value curves.[48]

When describing bidders in the Dutch auction, Vickrey has said the following:

> The knowledge that each bidder has about the motives and probable behavior of the others can be derived from a set of probability distributions from which the value of the object to each of the bidders is conceived to be drawn. For simplicity, we shall assume that all bidders have the same conception of the probability distribution from which any given player is deemed to derive the value he places on the object; the given player, of course, knows the actual value he places on the object but is assumed also to know the distribution from which others consider his value to be drawn.[49]

For instance, "if players conform to this norm" Marines that desire to reenlist will reveal their true willingness to accept a reenlistment.[50] In a specific application, Marines will portray to others the monetary value that they place on continued service, within the Marine Corps, by providing their reservation value. Marines will then fall into two categories: Marines with a high opportunity cost and Marines with a low opportunity cost. Marines that have a high opportunity cost, or more opportunities for a better paying civilian job, will bid high, and it will require more money to retain these individuals. Marines that have a lower opportunity cost, or those who have less opportunity for a better paying civilian job, will bid low, and it will require less money to retain these persons. Ultimately, the measurement of opportunity costs, via the Sequential Self-Selecting Auction Mechanism (S^3AM), enables Marine SRB planners to appropriately gauge the SRB to be paid.

The hallmark of Vickrey's work is the concept of a sealed-bid second-price auction. Vickrey describes the sealed-bid second-price auction in the following way:

> It is easily shown that the required procedure to ask for bids on the understanding that the award will be made to the highest bidder, but on the basis of the price set by the second highest bidder. If this procedure is carried out, then the optimal strategy for each bidder (assuming, as is indeed necessary in the analysis of the progressive auction itself, the absence of collusion among bidders) will obviously be to make his bid equal to the full value of the article or contract to himself…[51]

Once again, Vickrey emphasizes the importance of an individual submitting a bid that reflects their true value

for the item, which becomes their reservation value. Specific to this thesis, a Marine that faces the decision to reenlist, must decide upon two key items: what is their opportunity cost, and how much do they value a continuation of their active duty service. The combination of these factors will then determine the individual's ultimate reservation value. Once these two questions are answered, in a second-price reenlistment auction, the Marine should submit a sealed-bid that accurately reflects his or her reservation value for continued service.

2. Paul Milgrom

Paul Milgrom's article, "Auctions and Bidding: A Primer," addresses many of the same points that Vickrey has made in his article regarding the optimal strategy for auctions. Additionally, Milgrom expands upon additional auction theory concepts, such as: the independence assumption, the private values assumption, the Nash equilibrium, the revenue equivalence theorem, and optimal bidder strategies. The proceeding paragraphs will explore each in turn.

Milgrom defines the independence and private values assumption as the following: "the independence assumption means that there is no unobserved common factor affecting all of the competitor's bids while the private values assumption allows the contractor to ignore the competitor's information in forming its cost estimate."[52] The independence assumption allows bidders to make "statistically independent" bids that may be predicated on historical bidding patterns, and the private values

assumption is based upon personal opportunity costs.[53]
These concepts are significant for accurate planning
purposes. In particular, it is reasonable for SRB planners
to assume that Marine opportunity costs reflect independent
private values (or costs) for continued active duty service.
In other words, one Marine's willingness to reenlist (the
minimum bonus he would need to receive to reenlist) is a
function of his own personal and professional circumstances
and is unrelated to the willingness to reenlist of other
Marines.

Nash equilibrium is a solution concept named after the
Nobel Laureate John Nash. The premise of the Nash
equilibrium concludes that market participants will choose
their optimal strategy based upon the expected strategy of
the other market participants. Milgrom in his discussion of
the Dutch and first-price sealed-bid auction has said:

> That is, the sets of strategies are identical and
> the outcome rules that transform strategies into
> allocations are identical. Since solution
> concepts like the Nash equilibrium work on
> strategic forms, these concepts predict
> powerfully that the identity of the winner and
> the price the winner pays will always be the same
> for these two kinds of auctions.[54]

The Nash equilibrium solidifies the argument that a Dutch
auction and a first-price sealed-bid auction are
strategically equivalent.

Milgrom makes mention of the revenue equivalence
theorem in order to prove that the variety of auctions all
yield the same expected revenue. Specifically, Milgrom has
said:

The English and sealed bid auctions yield exactly
the same expected profit for every bidder
valuation and the same expected revenue for the
seller. Indeed, every auction that allocates the
goods efficiently and offers no profit to a zero
valuation bidder has the same expected profits
for every bidder valuation and the same expected
revenue for the seller.[55]

The main premise from the previously mentioned quote is that

auctions allocate goods efficiently. However, as will be

pointed out later, by both Milgrom and the empirical

evidence provided in this chapter, the S^3AM will allow the

bid-taker to capture more of the surplus than under a simple

single auction format.

Because the S^3AM employs a generalization of the

second-price auction, if the Marine Corps were to adopt the

S^3AM in lieu of the current SRB program, the optimal

strategy for Marines competing for reenlistments would be

for them to submit a sealed-bid that accurately reflects

their value of the reenlistment. In other words, a Marine

who is eligible for reenlistment must determine their

opportunity cost for remaining in the Marine Corps and

determine their reservation value. When describing the

optimal individual strategy, Milgrom has said:

From the perspective of an individual bidder, the
price he names merely specifies the lowest price
at which he will be willing to undertake
production. So it is a dominant strategy for
each bidder to name a price equal to his marginal
cost c; that way he accepts all offers to produce
output at a price exceeding his cost per unit,
and no other offers.[56]

Simply stated, a Marine that faces the reenlistment decision, under the S^{3}AM based SRB program must do two things:

- Create an individual cost benefit analysis that accounts for remaining within the active duty Marine Corps (opportunity cost).
- Submit a sealed-bid that accurately reflects their value of continued active service, their reservation value.

3.   McAfee and McMillan

Preston McAfee and John McMillan in their article, "Auctions and Bidding," have discussed the basic auction theory model and the revelation principle. These two significant concepts will be discussed in the proceeding paragraphs. McAfee and McMillan define the basic auction model, which they refer to as the "benchmark model," with the following assumptions:

A1. The bidders are risk neutral.

A2. The independent-private-values assumption applies.

A3. The bidders are symmetric.

A4. Payment is a function of bids alone.[57]

McAfee and McMillan's benchmark model was used to analyze the four basic types of auctions, each of these auctions were discussed in Chapter II. The authors were able to conclude that "each of these auction forms yields on average the same revenue to the seller."[58] They were able to make this conclusion based upon the Revenue Equivalence Theorem.

McAfee and McMillan describe the Revelation Principle as, "a tool used" to determine the optimal auction for the seller.[59] The authors describe an optimal auction by: "the seller asking the bidders how much they value the item and the bidders responding by honestly reporting their valuations to the seller."[60] In the case of the Marine Corps' using the proposed S^3AM for SRBs, a Marine that has a high opportunity cost for remaining within the active duty Marine Corps would bid high for a reenlistment bonus. This is the case because a Marine with a high opportunity cost would earn higher wages in the civilian marketplace and these wages would be lost if the Marine were to remain on active duty. A Marine with a low opportunity cost would bid low for a reenlistment bonus for two reasons: one, the Marine is motivated not only by pay, but also through the utility of serving. The second reason is that, in the private sector, the Marine would be earning wages equal to or less than they were earning now.

C.   EMPIRICAL RESULTS FROM AUCTIONS

1.   David Lucking-Reiley

David Lucking-Reiley in his article "Using Field Experiments to Test Equivalence Between Auction Formats: Magic on the Internet," talks about how he used different auction types to sell Magic trading cards on the internet, which he describes in the following way:

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For this study, I purchased over $2,000 of Magic
cards and resold them via auctions in the
Internet marketplace. The basic procedure was to
auction two copies of the same card via two
different auction mechanisms, to make direct
comparisons of the revenue earned in each one.[61]

The two types of auctions that Lucking-Reiley used were the
Dutch and first-price auctions.[62] The first day of trading
on the internet, yielded 15% more revenue with the Dutch
auction, than it did for the first-price auction.[63]
Additionally, the author has provided summary statistics for
total sales in several tables throughout his study.

Table 1 under the first column, lists the mean log
difference for the Dutch auction as .293.[64] The mean log
difference is important, because it allows you to make the
following conclusion: when holding all things constant, the
Dutch auction on average will yield 29.3% more revenue than
the first-price auction.

Table 1.   Dutch/First-Price Revenue Differences[65]

	Experiment FD	Experiment DF
All observations	87	86
Dutch revenue higher	63	59
Equal revenue	12	5
First-price revenue higher	12	22
Mean Dutch-first difference	$ 0.38	$ 0.25
(Standard deviation of mean)	(0.07)	(0.17)
Mean log difference	0.293	0.288
(Standard deviation of mean)	(0.038)	(0.059)
Wilcoxon statistic	5.66	2.78
Restricted sample[a]	82	86
Dutch revenue higher	62	59
Equal revenue	8	5
First-price revenue higher	12	22
Mean Dutch-first difference	$ 0.40	$ 0.25
(Standard deviation of mean)	(0.07)	(0.17)
Mean log difference	0.303	0.288
(Standard deviation of mean)	(0.039)	(0.059)
Wilcoxon statistic	6.15	2.78

As Lucking-Reiley has said:

> These field experiments provide, for the first
> time, evidence from real-world auctions that
> allow revenue comparisons between the four basic
> auction formats. They indicate that Dutch
> auction revenues exceed first-price auction
> revenues, and English auction revenues are not
> significantly higher than second-price auction
> revenues.[66]

2.   van den Berg, van Ours, and Pradhan

Gerard J. van den Berg, Jan C. van Ours, and Menno P.
Pradhan, in their article, "The Declining Price Anomaly in
Dutch Rose Auctions," examined data from the Aalsmeer Flower

Auction (AFA) to analyze price movements from sequential auctions.[67] The authors have described their study, as the following:

> In contrast, our data concern sequential auctions in which auctioned lots consist of many units and each lot is fully homogenous. Our results therefore provide additional insight into the nature of the declining-price phenomenon.[68]

This study warrants a closer look because the proposed S^3AM for the Marine Corps' SRBs, also auctions off homogenous items, reenlistments, in a sequential manner. Furthermore, this study again illustrates that an appropriately designed auction allows the producer to capture more of the surplus.

The authors created a pricing model and then ran a fixed effect regression. The t-statistic from their fixed effect regression clearly portrays a decline in prices. Specifically, the average t-statistic, for all of the modeled transactions is −2.4.[69] This allows you to conclude that when holding all other things constant; on average, the prices that were paid for the roses declined 2.4% for all of the 7,058 observed transactions.[70]

D.   CHAPTER SUMMARY

"Auctions have been used for more than 2500 years to allocate a single indivisible asset."[71] When properly constructed, auctions become a formidable tool that a producer may wield. If a producer chooses to transact with consumers, through a properly structured auction mechanism, they afford themselves the opportunity to capture more of the economic surplus. In the case of this thesis, the S^3AM will save the Marine Corps money. The Marine Corps is able

to save money, because the S^{3}AM enables the Marine Corps to capture more of the economic surplus. The exact amount of economic surplus will be presented in Chapter IV. Furthermore, the S^{3}AM will provide a flexible force shaping tool to the Marine Corps' SRB planners.

IV. A PRACTICAL APPLICATION OF THE SEQUENTIAL SELF-SELECTION AUCTION MECHANISM (S³AM)

A. CHAPTER OVERVIEW

This chapter illustrates the significant potential cost savings that could be generated through using the S³AM, in lieu of the Marine Corps' current SRB program. Furthermore, this chapter will furnish the reader with S³AM examples from three Marine Corps Military Occupational Specialties (MOSs), with two types of annual contracts, a short-term and a long-term. The following four mixes of contracts will be examined: a two year/four year combination, a two year/six year combination, a three/six year combination, and a four year/six year combination.

In order to meet FTAP endstrength requirements, each of the MOSs mentioned in this chapter were paid bonuses during fiscal year (FY) 2006. In other words, the samples presented were drawn from the Marine Corps' FY 2006 Zone A population. The sample MOSs consisted of: 0311 (Infantry Rifleman), 0621 (Field Radio Operator), and 5811 (Military Policeman).

B. S³AM OVERVIEW

1. Conceptual Framework of the S³AM

The S³AM is based upon sequential sealed-bid second-price auctions and is designed to allow individuals to self-select into two categories; these categories may be derived from a Marine's retention signals which are based upon their

willingness to accept a reenlistment.[72] These two retention
categories consist of: those relatively more willing to
reenlist for a long-term contract, and those relatively more
willing (or at least equally willing) to reenlist for a
short-term contract.[73] Conceptually, this separation occurs
because Marines with a low opportunity cost or a high
penchant for active duty service would be willing to accept
a long-term contract with a lower bonus to secure their
future military employment. Marines with a high opportunity
cost, on the other hand, would require a higher bonus to
reenlist and consequently self-select into a shorter-term
reenlistment, which provides a higher bonus.

The construct of the S^3AM must contain the following
items and adhere to the following guidelines:

- For each MOS, conduct two sequential sealed-bid
  second-price auctions for reenlistments that have
  a short-term commitment (first auction) and a
  long-term commitment (second auction), such as
  three year and a six year contracts.[74]

- In each auction, eligible Marines within that MOS
  will submit a bid representing the minimum bonus
  amount that they would be willing to accept in
  return for reenlistment for the specified number
  of years.

- Because each auction is a reverse auction, the
  winning bidders will be those who submit the
  lowest bids (or reenlistment bonus amounts).

- "Participation would constitute a binding
  commitment,"[75] for any bidder who submits a
  winning bid. If a bidder submits a winning bid
  for both the short-term and long-term auction,
  that Marine would receive the long-term
  reenlistment bonus and be subject to the long-term
  reenlistment term. Note that, in such a case, the
  long-term contract would be the Marine's preferred
  contracts as indicated by their bids.[76]

➢ The cutoff amount, or the bonus paid to all Marines under each contract term, would be the first excluded bid for each of the auctions (i.e. the lowest bid among the "losers" of the auction). The S^3AM provides endstrength planners flexibility in meeting manpower requirements. For example, the bonus cutoffs could coincide with an increase or decrease of personnel requirements within the Enlisted Career Force, which increases or decreases the reenlistment percentages. Additionally, endstrength planners could seek to maximize the number of reenlistments which adhered to budgetary constraints.[77]

➢ Cost savings from use of the S^3AM are maximized when there is an element of uncertainty about future reenlistment opportunities for Marines who accept short-term contracts, which is best expressed as a probability. For example, Marines who are reenlisted under a short-term contract may face the possibility that future budgetary constraints or endstrength requirements (in particular MOSs or across-the-board) may limit the number of Marines who are offered reenlistment bonuses at the end of the short-term contract. The element of uncertainty induces more individuals to accept the long-term contract (especially among those Marines most interested in securing their long-term employment in the Marine Corps), because of the certainty of employment and the security that is inherent with a steady income. Consequently, the Marine Corps is able to capture more of the surplus.

➢ The fact that truthful revelation is the optimal bidding strategy in the first auction is valuable for the following two reasons. First, when a Marine reveals their true reservation value for a reenlistment, this allows the SRB planner to confirm the relevance of the opportunity costs for each of the respective MOSs. Secondly, the second auction would allow SRB planners to estimate the risk aversion levels of the bidders, based upon their bidding behavior.

2. The S³AM Practical Application

In practice, application of the S³AM would proceed in the following five stages:

1. All Marines that are eligible for a reenlistment contract for that particular MOS, submit bids for the short-term contract that are indicative of their willingness to accept a reenlistment for the short-term contract (i.e. their bid indicates the minimum bonus they would be willing to accept to reenlist).

2. The SRB planners only accept the percentage of winning bids that would allow them to meet endstrength requirements. For example, if there were 3,000 1371s that were eligible for reenlistment and the FTAP quota required 15% of the eligible Marines, then the Marines who submitted the 450 lowest bids would be selected for reenlistment; no other Marines in this occupational field would be offered reenlistment.

3. The SRB planners determine the first excluded bid for the short-term auction, which becomes the SRB that would be paid to each of the Marines under the short-term contract. In other words, all reenlisted Marines who end-up reenlisting under the short-term contract are paid the same reenlistment bonus. Note that the bonus that each Marine is paid will be <u>higher</u> than his or her submitted bid for the short-term auction.[78]

4. The 450 Marines who submitted the lowest bids in the first auction would then submit bids indicating what they would need to be paid to reenlist for a guaranteed long-term contract, based on the short-term bonus for which they were already approved.

5. The Enlisted Endstrength Planners will determine the appropriate mix of short-term and long-term contracts based on budgetary constraints, force-shaping needs and other appropriate factors. The corresponding numbers of Marines with the lowest bids for the long-term contracts, are then given the long-term reenlistment. The first excluded

bid from the long-term contract becomes the long-term reenlistment bonus based upon the remaining FTAP quota.

3.   The Optimal S³AM Strategy for the First Auction

Because the auction is a second-price auction, the optimal strategy in the first auction is for Marines to truthfully reveal their reservation value for a short-term reenlistment. In other words, how much money will it take to keep a Marine on active duty and within his or her current MOS. Truthful revelation is important because Marines self-select into one of two categories: Marines who want to continue to remain on active duty and Marines that do not. When weighing this decision, a Marine with a high opportunity cost requires a larger bonus to stay; a Marine with a low opportunity cost requires a smaller bonus to stay.

4.   The Optimal S³AM Strategy for the Second Auction

The second round auction is also a second-price auction, so the dominant strategy is again to truthfully reveal the minimum bonus that you would be willing to accept in order to reenlist for a long-term contract. Note that the minimum amount a Marine would be willing to accept for a long-term reenlistment depends on: (1) his or her opportunity cost of remaining in the Marine Corps,(2) the amount of the short-term bonus (which he or she is already guaranteed), (3) the relative length of the short-term vs. long-term contracts, and (4) that particular Marine's perceived probability that he or she would be offered

reenlistment for another short-term contract (with a similar short-term bonus) after completion of the initial short-term reenlistment contract.

Consequently, the optimal amount for any Marine to bid in the auction for the long-term reenlistment contract can be derived from an economic break-even point formula between a certain long-term contract and short-term contract with uncertainty concerning follow-on short-term reenlistment bonuses. Assuming a risk-neutral bidder, the break-even point is given by the following formula:

$$L = S(1-p^M)/M(1-p)+C[1-(1-p^M)/M(1-p)]^{79}$$

The variables in this break-even formula represent the following values:

> L = the break-even value for the long-term bonus (i.e.,the Marine's optimal bid)

> S = short-term contract bonus as determined in the first auction

> P = the particular Marine's perceived probability that he or she would be offered reenlistment for another short-term contract (with a similar short-term bonus) after completion of the initial short-term reenlistment contract

> M = the multiple between the short-term and long-term contracts (i.e. the ratio between the number of years under the long-term contract to the number of years under the short-term contract)

> C = the particular Marine's opportunity costs of remaining on active duty in the Marine Corps.

In the case of this thesis, the opportunity costs may be derived from the logistic regressions derived from two separate Center for Naval Analyses studies (CNA).[80] These studies sought to predict the percentage of enlisted Marines that would reenlist, within a certain MOS, when the

Marines were offered an SRB. The first study, by James H.
North, entitled "A Cost-Effective Use of Selective
Reenlistment Bonuses and Lateral Occupational Moves," was
published in 1994. The second study, by Anita U.
Hattiangadi et al., entitled, "Cost-Benefit Analysis of
Lump Sum Bonuses for Zone A, Zone B, and Zone C
Reenlistments: Final Report," was published in 2004. Table
8 from the North study and Table 6 from the Hattiangadi
study help generate the opportunity cost curves for each
MOS, at the five SRB multiple levels.[81] The graph depicted
in Figure 3, shows the shape of the opportunity cost curves
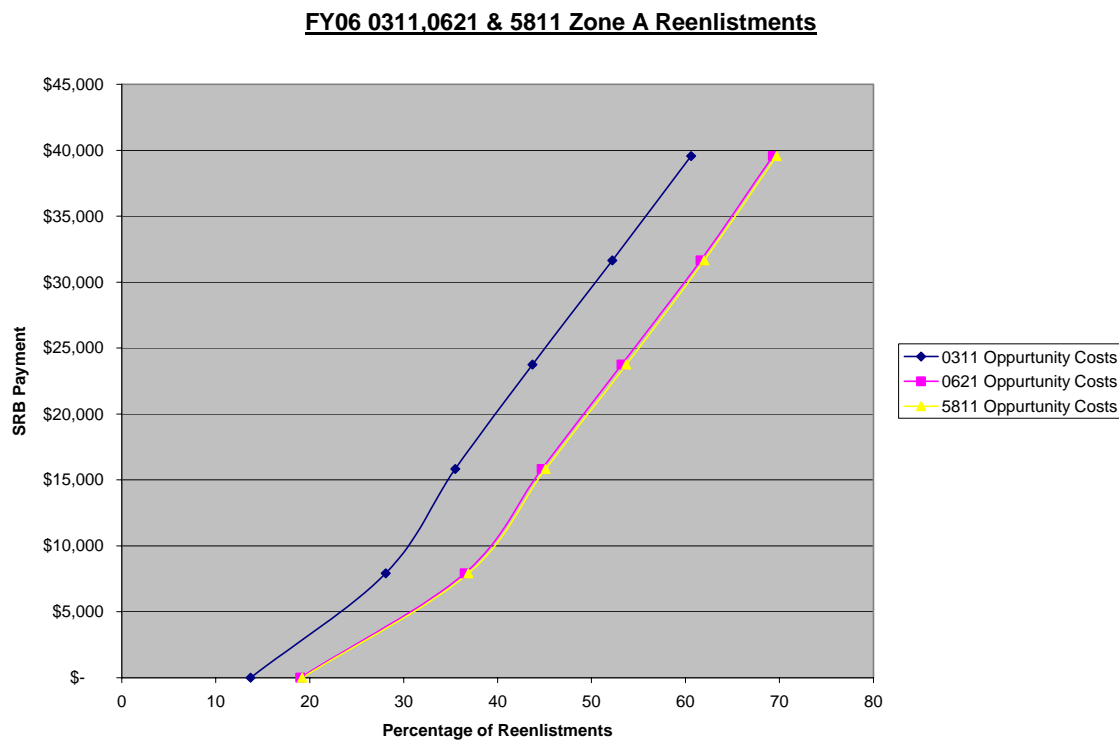for FY06 0311s, 0621s, and 5811s.

FY06 0311,0621 & 5811 Zone A Reenlistments

Figure 3.   FY06 0311,0621, & 5811 Opportunity Costs[82]

5.   Key Points and Assumptions

To estimate the potential cost savings that the Marine Corps could garner by implementing the S^3AM, certain assumptions were made in the analysis, which include the following:

➢ Each Marine perceives that, if he reenlists for a short-term contract now, there is a 60% probability that he will be offered another short-term reenlistment contract at the end of that initial contract. If the actual probability is lower than 60%, the Marine Corps would capture a greater potential cost savings because of the uncertainty associated with a short-term commitment decision.

➢ 70% of the end of active service (EAS) population is eligible for reenlistment. The figure of 70% was employed to bias downward the potential savings that the S^3AM would generate and thus provide a conservative estimate. This prudent action was undertaken to avoid overstating the vast savings that could be created if the S^3AM were implemented, and to add some realism into the theoretical S^3AM model calculations.

➢ The EAS population numbers were derived from the data contained within the Marine Corps' 7220 Bulletin series, entitled, "FTAP Mission Marine Administrative Message," number 476/05, which was dated on October 14, 2005.[83]

➢ The Marine Corps will continue to pay bonuses as lump sums vice annual installments.

➢ The opportunity costs used reflect FY 2006 data, which were obtained from the Marine Corps' SRB planner.

➢ The S^3AM bonus cost for each of the MOSs examined is purposely overstated. The S^3AM cost is higher because the model was run using the numbers for the FTAP quota vice the numbers of Marines who were actually paid an SRB. For instance, in FY 2006 the FTAP quota for 0311s was 504 Marines, but only 482 Marines were paid an SRB; as a result,

the S^3AM bonus cost calculated below is slightly higher that it would actually have been if it were implemented and used during FY 2006.[84] Consequently, the potential savings from employing the S^3AM is again a conservative understatement.

➢ The opportunity costs employed were calculated assuming a Corporal/E4 with four years time in service and a four year service commitment. The pay data originated from the 2006 pay table.

The S^3AM spreadsheet allows you to derive the short-term and long-term bonus amounts that should be paid to each MOS. The bonus amounts paid out to the Marines are based upon their opportunity costs and these opportunity costs are derived from the CNA's logistic regression. Specifically, as the CNA stated in their 2004 study, "each spring, CNA uses the model to forecast reenlistment responses by occfield to SRBs from level 0 (no SRB) to level 5."[85] As a result, the CNA is able to produce an occupational field (occfld) specific table that predicts Zone A reenlistment percentages with SRB bonus multiples that range from zero to five. The FY 2006 Zone A reenlistment table is depicted in Table 2.

Table 2.   FY 2006 Zone A Reenlistment Percentages[86]

| | SRB Levels | | | | | | | | | | |
OCC	0	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5
01	35.0%	46.0%	56.9%	61.0%	65.1%	68.7%	72.4%	75.5%	78.7%	81.3%	83.9%
02	24.7%	34.6%	44.5%	48.8%	53.0%	57.2%	61.4%	65.3%	69.1%	72.5%	75.9%
03	13.7%	20.9%	28.1%	31.8%	35.5%	39.6%	43.7%	47.9%	52.2%	56.4%	60.6%
04	23.7%	33.5%	43.3%	47.5%	51.8%	56.0%	60.2%	64.1%	68.1%	71.5%	75.0%
05	21.4%	30.7%	40.1%	44.3%	48.5%	52.7%	57.0%	61.0%	65.1%	68.8%	72.4%
06	19.0%	27.7%	36.5%	40.6%	44.7%	49.0%	53.2%	57.4%	61.6%	65.4%	69.3%
08	16.5%	24.6%	32.7%	36.7%	40.6%	44.8%	49.1%	53.3%	57.6%	61.6%	65.6%
11	20.6%	29.8%	38.9%	43.1%	47.3%	51.6%	55.8%	59.9%	64.0%	67.8%	71.5%
13	21.1%	30.3%	39.5%	43.7%	47.9%	52.2%	56.5%	60.5%	64.6%	68.3%	72.0%
18	15.9%	23.7%	31.6%	35.5%	39.4%	43.6%	47.8%	52.1%	56.3%	60.4%	64.5%
21	19.7%	28.6%	37.6%	41.7%	45.9%	50.1%	54.4%	58.5%	62.7%	66.5%	70.3%
23	20.5%	29.6%	38.8%	42.9%	47.1%	51.4%	55.7%	59.8%	63.9%	67.6%	71.3%
26	16.6%	24.7%	32.8%	36.8%	40.7%	45.0%	49.2%	53.4%	57.7%	61.7%	65.7%
28	15.0%	22.5%	30.1%	33.9%	37.8%	41.9%	46.1%	50.3%	54.6%	58.8%	62.9%
30	30.0%	40.6%	51.2%	55.4%	59.7%	63.6%	67.6%	71.1%	74.6%	77.5%	80.5%
31	31.4%	42.1%	52.9%	57.1%	61.3%	65.1%	69.0%	72.4%	75.8%	78.7%	81.5%
33	22.8%	32.4%	41.9%	46.2%	50.4%	54.7%	58.9%	62.9%	66.9%	70.4%	74.0%
34	32.5%	43.4%	54.2%	58.3%	62.5%	66.3%	70.1%	73.4%	76.7%	79.5%	82.3%
35	20.7%	29.9%	39.0%	43.2%	47.4%	51.6%	55.9%	60.0%	64.1%	67.8%	71.5%
41	67.9%	75.9%	83.8%	85.9%	87.9%	89.5%	91.1%	92.3%	93.5%	94.4%	95.3%
43	22.5%	32.1%	41.6%	45.8%	50.1%	54.3%	58.6%	62.5%	66.5%	70.1%	73.7%
44	36.1%	47.1%	58.1%	62.1%	66.1%	69.7%	73.3%	76.4%	79.5%	82.0%	84.5%
46	28.9%	39.4%	49.9%	54.2%	58.4%	62.4%	66.4%	70.0%	73.6%	76.6%	79.7%
55	32.0%	42.8%	53.6%	57.8%	61.9%	65.8%	69.6%	73.0%	76.3%	79.1%	82.0%
57	25.2%	35.3%	45.3%	49.5%	53.8%	58.0%	62.1%	66.0%	69.8%	73.1%	76.5%
58	19.2%	28.1%	36.9%	41.0%	45.1%	49.4%	53.7%	57.8%	62.0%	65.8%	69.7%
59	17.8%	26.2%	34.7%	38.7%	42.8%	47.0%	51.3%	55.5%	59.7%	63.7%	67.6%
60	20.5%	29.6%	38.8%	42.9%	47.1%	51.4%	55.6%	59.8%	63.9%	67.6%	71.3%
61	17.4%	25.7%	34.0%	38.0%	42.0%	46.3%	50.5%	54.7%	59.0%	62.9%	66.9%
62	14.1%	21.4%	28.7%	32.5%	36.2%	40.3%	44.4%	48.7%	53.0%	57.1%	61.3%
63	16.6%	24.7%	32.8%	36.8%	40.8%	45.0%	49.2%	53.5%	57.7%	61.8%	65.8%
64	16.6%	24.7%	32.9%	36.8%	40.8%	45.0%	49.2%	53.5%	57.7%	61.8%	65.8%
65	21.6%	31.0%	40.3%	44.6%	48.8%	53.0%	57.3%	61.3%	65.4%	69.0%	72.7%
66	29.3%	39.9%	50.4%	54.7%	58.9%	62.9%	66.9%	70.4%	74.0%	77.0%	80.0%
68	21.8%	31.2%	40.6%	44.8%	49.0%	53.3%	57.5%	61.6%	65.6%	69.2%	72.9%
70	21.8%	31.2%	40.6%	44.8%	49.0%	53.3%	57.5%	61.5%	65.6%	69.2%	72.8%
72	16.4%	24.4%	32.4%	36.4%	40.3%	44.5%	48.7%	53.0%	57.2%	61.3%	65.3%
73	21.2%	30.4%	39.7%	43.9%	48.1%	52.4%	56.6%	60.7%	64.8%	68.5%	72.1%

Once the applicable occupational field opportunity costs are incorporated into the spreadsheet, the next step is to determine the FTAP quota and the eligible MOS reenlistment population size. These numbers are entered into the spreadsheet and then the break-even opportunity cost is calculated using the formula mentioned previously. Once this break-even value is computed, the spreadsheet will calculate the number of short-term and long-term contracts and their respective bonus amounts. The division between short and long-term contracts can reflect budgetary or force shaping consideration, or other relevant factors. In this

analysis, the mix of short-term and long-term contracts was chosen to minimize the total bonus cost over the length of the short-term contract for that occupational field. When holding all other things constant, the number of Marines that would theoretically commit to a short-term and long-term contract will equal the desired FTAP quota. Specific examples for the MOSs of 0311, 0621, and 5811 will be covered in the subsequent sections of this chapter.

C. POTENTIAL 0311 ZONE A REENLISTMENT COST SAVINGS

1. Two and Four Year Contracts

The FY06 0311 E5, E4, and E3 EAS population size was approximately 3,500 Marines.[87] Of those Marines, 70% are assumed to be eligible for reenlistment, which yields a corrected population size of 2,450 Marines; 482 Marines were actually paid an SRB, and the FTAP quota was 504 Marines.[88] The FY06 0311 Zone A bonus multiple was 4; the total actual SRB paid was $13,709,225; and the average SRB per Marine was $28,442.[89] When holding all other things constant, the S^3AM model produces the following results:

Table 3.   0311 Two and Four Year Contracts with Four Year Annual Conversion

	Number of Marines	**S^3AM Annual Bonus**
Short-term Contract	179	$1,006.00
Long-term Contract	325	$810.00
Total S^3AM Cost	504	$443,261.00
Actual FY06 SRB	482	$3,427,306.00
Potential Savings	**504**	**$2,984,046.00**

The lump sum potential savings may be calculated as:

- ➤ Total annual S^3AM cost = (the number of short-term contracts * short-term annual bonus amount) + (the number of long-term contracts * long-term annual bonus amount).

- ➤ S^3AM potential savings = (actual annual FY06 SRB cost) – (S^3AM total annual cost).

2.   Two and Six Year Contracts

When applying the S^3AM to the selection between two and six year contracts, the Marine population parameters and the numbers of short-term and long-term contracts have remained the same as above. However, the long-term contract bonus paid to 325 Marines has changed. This change has occurred because Marines that favor a longer commitment have a lower break-even value because of the added risk associated with the larger time difference between the short and long-term contracts. Table 4 annotates the changes and the potential savings.

Table 4.   0311 Two and Six Year Contracts with Four Year Annual Conversion

	Number of Marines	**S^3AM Annual Bonus**
Short-term Contract	179	$1,006.00
Long-term Contract	325	$665.00
Total S^3AM Cost	504	$393,335.00
Actual FY06 SRB	482	$3,427,306.00
Potential Savings	**504**	**$3,030,971.00**

3.   Three and Six Year Contracts

The three year and six year contracts yield the exact same results as the two and four year contracts because the short and long-term contracts have the same multiple of two, in both cases (i.e. because 4/2 = 6/3 = 2). Therefore, the three and six year contracts will not be addressed here for the 0311 MOS, nor for either the 0621 or the 5811 MOSs. However, it should be understood that the potential annual savings are the same as for the two year and four year contract combination.

4.   Four and Six Year Contracts

Four and six year contracts share the same population parameters, as mentioned above, but there is a change in the potential overall savings and the bonuses paid to Marines. Table 5 illustrates the annual cost conversion for the short-term and long-term contracts and the specific potential savings.

Table 5.   0311 Four and Six Year Contracts with Four Year Annual Conversion

	Number of Marines	S^3AM Annual Bonus
Short-term Contract	179	$1,006.00
Long-term Contract	325	$900.00
Total S^3AM Cost	504	$472,718.00
Actual FY06 SRB	482	$3,427,306.00
Potential Savings	**504**	**$2,954,588.00**

D.   POTENTIAL 0621 ZONE A REENLISTMENT COST SAVINGS

1.   Two and Four Year Contracts

The FY06 0621 E5, E4, and E3 EAS population size was approximately 943 Marines with a corrected population size of 660 eligible Marines.[90] The FY 2006 FTAP quota required a reenlistment of 246 Marines, however only 200 Marines actually executed the FTAP and all 200 were paid an SRB.[91] The FY06 0621 Zone A bonus multiple was 1.5; the total actual SRB paid was $2,292,916; and the average SRB was $11,464.[92] When holding all other things equal, the S^3AM model has produced the following results:

Table 6.   0621 Two and Four Year Contracts with Four Year Annual Conversion

	Number of Marines	S^3AM Annual Bonus
Short-term Contract	120	$1,969.00
Long-term Contract	126	$1,585.00
Total S^3AM Cost	246	$436,078.00
Actual FY06 SRB	200	$573,229.00
Potential Savings	**246**	**$137,151.00**

The lump sum potential savings may be calculated as:
  ➢   Total annual S^3AM cost = (the number of short-term contracts * short-term annual bonus amount) + (the number of long-term contracts * long-term annual bonus amount).

  ➢ S^3AM potential savings = (actual annual FY06 SRB cost) − (S^3AM total annual cost).

2. Two and Six Year Contracts

The two and six year contracts stipulate that the same short-term bonus be paid, but reduces the amount of the long-term bonus.

Table 7.   0621 Two and Six Year Contracts with Four Year Annual Conversion

	Number of Marines	**S³AM Annual Bonus**
Short-term Contract	120	$1,969.00
Long-term Contract	126	$1,304.00
Total S³AM Cost	246	$400,611.00
Actual FY06 SRB	200	$573,229.00
Potential Savings	**246**	**$172,618.00**

3. Four and Six Year Contracts

The four and six year contracts reduce the potential savings because Marines that accept a long-term contract must be paid a larger bonus. Table 8 points out this disparity.

Table 8.   0621 Four and Six Year Contracts with Four Year
            Annual Conversion

	Number of Marines	**S^{3}AM Annual Bonus**
Short-term Contract	120	$1,969.00
Long-term Contract	126	$1,762.00
Total S^{3}AM Cost	246	$458,343.00
Actual FY06 SRB	200	$573,229.00
Potential Savings	**246**	**$114,886.00**

E.   POTENTIAL 5811 ZONE A REENLISTMENT COST SAVINGS

1.   Two and Four Year Contracts

The FY 2006 5811 E5, E4, and E3 EAS population size was
approximately 559 Marines with a corrected population size
of 391 eligible Marines.[93] The FY 2006 FTAP quota required a
reenlistment of 120 Marines. The FY06 5811 Zone A bonus
multiple was 1; the total actual SRB paid was $694,461; and
the average SRB was $7,310.[94] However, only 95 Marines were
actually paid an SRB.[95] Therefore, the potential savings
produced by the S^{3}AM is understated. The potential savings
are deflated, because the S^{3}AM bonus cost was calculated
based upon the FTAP quota which required 120 Marines. When
holding all other things equal, the S^{3}AM model has produced
the following results:

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Table 9.   5811 Two and Four Year Contracts with Four Year Annual Conversion

	Number of Marines	S^{3}AM Annual Bonus
Short-term Contract	52	$1,487.00
Long-term Contract	68	$1,195.00
Total S^{3}AM Cost	120	$158,565.00
Actual FY06 SRB	95	$173,615.00
Potential Savings	**120**	**$15,050.00**

The lump sum potential savings may be calculated as:

> ➢ Total annual S^{3}AM cost = (the number of short-term contracts * short-term annual bonus amount) + (the number of long-term annual contracts * long-term bonus amount).

> ➢ S^{3}AM potential savings = (actual annual FY06 SRB cost) − (S^{3}AM total annual cost).

2.   Two and Six Year Contracts

Table 10.   5811 Two and Six Year Contracts with Four Year Annual Conversion

	Number of Marines	S^{3}AM Annual Bonus
Short-term Contract	52	$1,487.00
Long-term Contract	68	$981.00
Total S^{3}AM Cost	120	$144,018.00
Actual FY06 SRB	95	$173,615.00
Potential Savings	**120**	**$29,598.00**

As table 10 illustrates, Marines that desire the
security of a six year contract are paid a lower bonus.
Subsequently, the lower long-term bonus increases the
overall savings that the Marine Corps could potentially
capture.

3. Four and Six Year Contracts

The 5811 population parameters remain the same for the
four and six year contracts, but there is a change in the
potential overall savings and the bonuses paid to Marines.
Table 11 illustrates the annual cost conversion for the
short-term and long-term contracts and the specific
potential savings.

Table 11.   5811 Four and Six Year Contracts with Four Year
            Annual Conversion

	Number of Marines	S^{3}AM Annual Bonus
Short-term Contract	52	$1,487.00
Long-term Contract	68	$1,329.00
Total S^{3}AM Cost	120	$167,697.00
Actual FY06 SRB	95	$173,615.00
Potential Savings	**120**	**$5,918.00**

F.   COMBINED TOTAL SAVINGS

Table 12 and Figures 4, 5 and 6 illustrate the
potential combined savings that the Marine Corps would have
incurred if the S^{3}AM were used in FY06. Please note that

the table and bar charts depicted in this section are calculated over a four year period and are not annual amounts. For the S^3AM two and six year options, these comparisons use the four year equivalent payment based on the annual bonus calculated above. Current Marine Corps policy stipulates that Marines reenlist for a period of three or more years, therefore the SRB multiples have been calculated as: (Marine's monthly base pay * SRB multiple * four year contract length). The combined savings in Table 12 reflect the reduction in the Marine Corps' traditional four-year lump-sum payment.

Table 12. Potential Combined Savings Over a Four Year Horizon

		Combined Savings		
Contract/MOS	0311	0621	5811	Total
2/4 Year	$11,936,183	$548,603	$60,200	$12,544,986
2/6 Year	$12,123,885	$690,471	$118,390	$12,932,746
4/6 Year	$11,818,354	$459,546	$23,672	$12,301,572
2/6 Year[96]	$12,391,201	$1,480,660	$467,416	$14,339,277

FY06 Combined Potential Savings for a 2 and 4 Year Contract
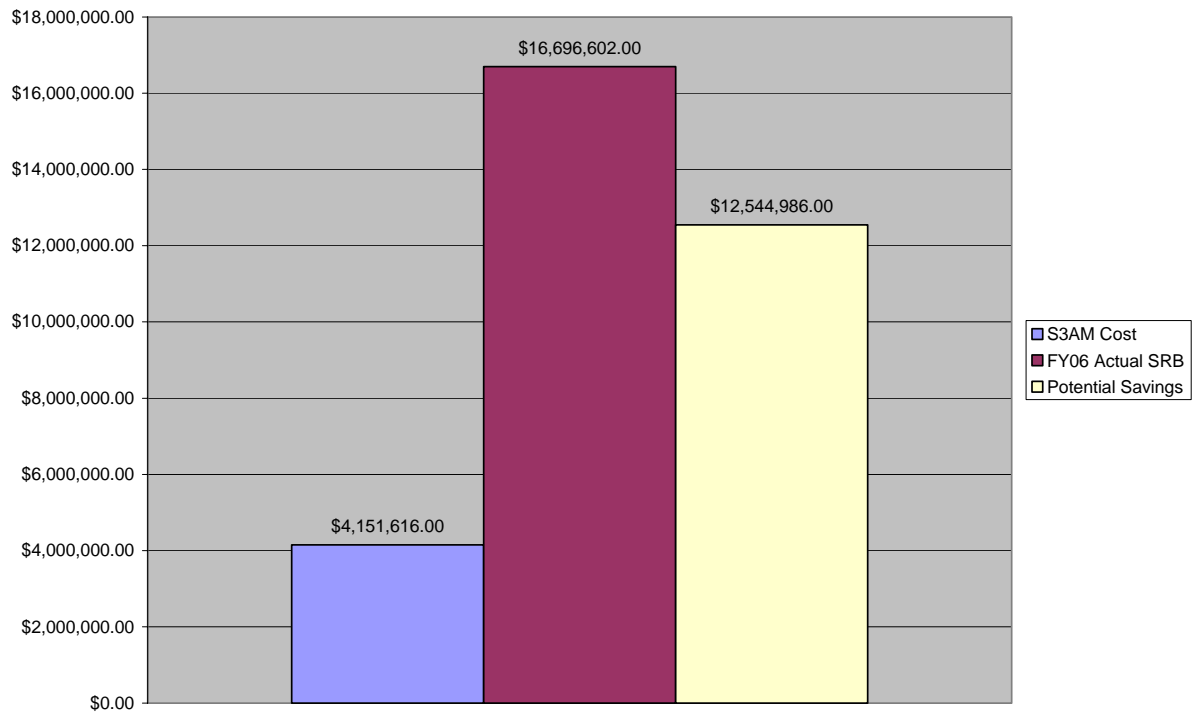

Figure 4.   FY06 0311, 0621, 5811 Combined Potential Savings
            for a 2&4 Year Contract

FY06 Combined Potential Savings for a 2 and 6 Year Contract
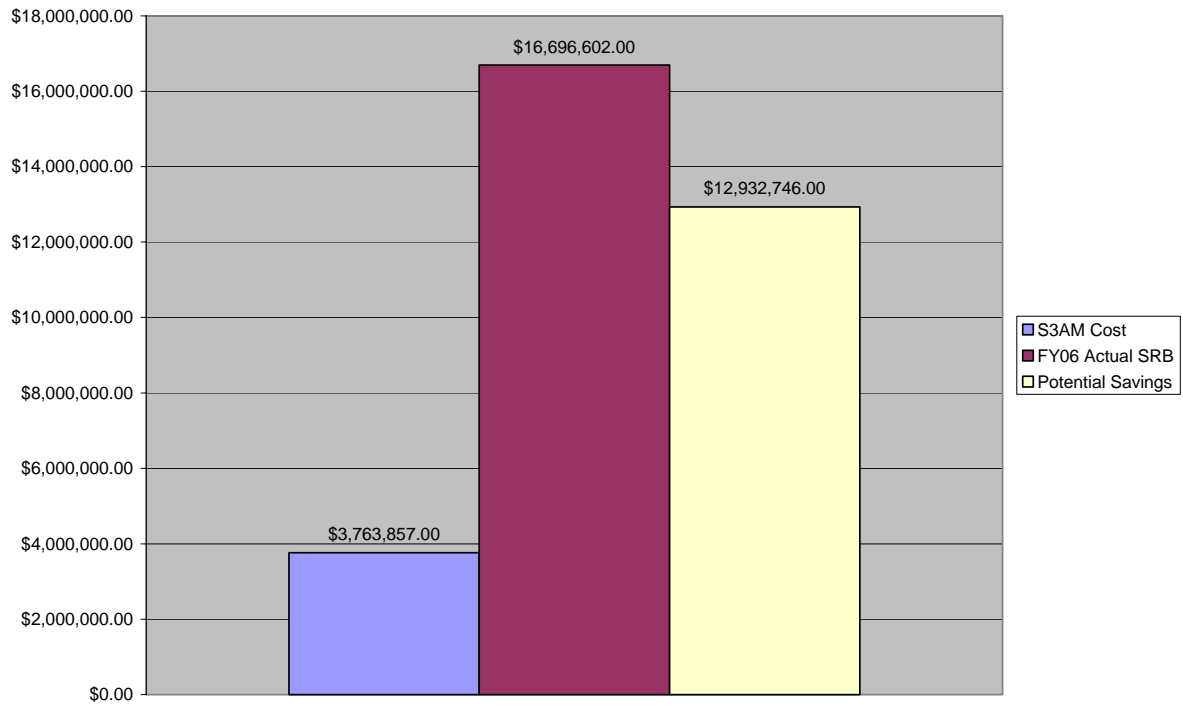

Figure 5.   FY06 0311, 0621, 5811 Combined Potential Savings
            for a 2&6 Year Contract

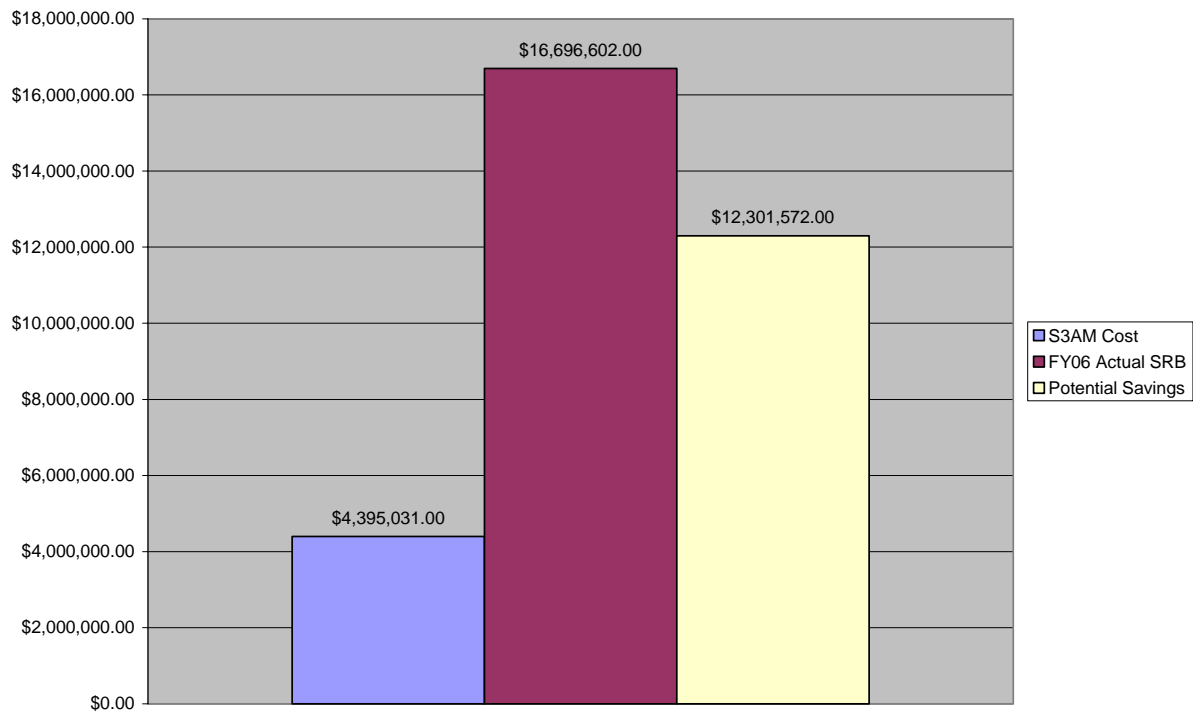**FY06 Combined Potential Savings for a 4 and 6 Year Contract**

Figure 6.   FY06 0311, 0621, 5811 Combined Potential Savings
            for a 4&6 Year Contract

G.   CHAPTER SUMMARY

The S[3]AM model could potentially save the Marine Corps
millions of dollars annually, while simultaneously ensuring
that endstrength requirements are being met, by an eligible
pool of Marines. Furthermore, the S[3]AM provides endstrength
planners with a dynamic force shaping tool that continues to
evolve with time and never becomes outdated. This occurs,
because opportunity costs are the fuel that power the S[3]AM
and the benchmark by which the SRB multiples are set.
Additionally, Marines that have high opportunity costs still
receive a monetary incentive for a reenlistment.

The S^{3}AM model affords endstrength planners the ability to make more cost effective decisions based on multiple contract options. On average, the two and six year contracts yield the largest potential savings, but a two year contract would require approval from the United States Congress.[97] Specifically, the two and six year contract option for 0311s, 0621s, and 5811s would have potentially saved the Marine Corps $12,123,885, $690,471, and $118,390, respectively, in FY 2006, based on a four year multiple. The potential cost savings for each set of short-term and long-term contracts has its advantages, some produce more potential savings and others may be more palatable for prospective reenlistees to accept. When holding all other things constant, every set of multiple contract options that were presented, theoretically produced a robust cost savings.

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V. CONCLUSION AND RECOMMENDATIONS

A. CONCLUSION

1. Primary Research Question Answered

The power of predicting behavior based upon opportunity costs is the theoretical underpinning of the Sequential Self-Selection Auction Mechanism (S^3AM). The S^3AM greatly reduces the payment of economic rent. The payment of economic rent is limited because the Marine Corps would only pay reenlisting Marines a monetary sum that more closely corresponds to their active duty opportunity cost. In other words, the S^3AM would allow the Marine Corps to capture more of the economic surplus, making the SRB process substantially more cost effective.

If the S^3AM were used in lieu of the current SRB program, the Marine Corps would potentially save tremendous amounts of money while still meeting endstrength requirements. For example, the S^3AM would have potentially saved the Marine Corps $12,932,746 in FY 2006 for just three occupational fields, over a four year time period. This savings would have been realized if the two and six year S^3AM model were used to pay FY 2006 bonuses to the 0311s, 0621s, and 5811s that reenlisted.

2. Secondary Research Question Answered

The S^3AM model allows endstrength planners to tailor contract options based upon the needs of the force. On average, the two and six year contracts yield the largest

potential savings, but a two year contract would require approval from the United States Congress. The Congress would be willing to make a legislative change if the S^{3}AM successfully met the following two conditions: will the S^{3}AM save the Federal government money and is the S^{3}AM something that could be replicated across the services. Clearly, the S^{3}AM has the potential to save large sums of money, as evidenced from the previous chapter. Secondly, the S^{3}AM is also something that could be implemented by the Department of Defense and passed on to the other services.

However, there are two other available options, which do not require Congressional approval. The two other options available to endstrength planners are: the three and six year contract option and the four and six year contract option. As illustrated in chapter IV, both of these contract options still yield potential savings.

B.   RECOMMENDATIONS FOR FURTHER STUDY

The theoretical applications of the S^{3}AM present substantial potential savings to the Marine Corps. However, theories must be proven and to be proven they must be rigorously tested. To adequately test the S^{3}AM, several iterations of economic experiments must be undertaken. The Naval Postgraduate School and the Defense Language Institute provide a pool of both officers and enlisted service members that could be used for the requisite experiments.

These economic experiments must be done for two reasons. The first reason is to determine if a service member's bidding behavior is indicative of their true opportunity costs, or if there are other factors that exert

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a significant influence on bidding behavior. The second reason is to determine the risk behavior of the bidders. Answers produced from these experiments will reveal how the S^3AM model could be constructed to yield the largest producer savings while still ensuring that eligible Marines are paid a cost effective bonus. Additionally, the crucial consumers of Marine Corps reenlistment are the Marines themselves and their families. Survey research should be conducted to determine what set of short-term and long-term contracts would solicit the most favorable responses.

Market participants respond to incentives and the Marine Corps' market for reenlistments is not atypical, therefore the implementation of sound economic polices would stand the test of time. The S^3AM provides endstrength planners with a uniquely flexible force shaping tool that awards deserving Marines a bonus, but does so in a more cost effective manner. Furthermore, the use of the S^3AM would generate multimillion dollar cost savings that would benefit the Marines, their families, the Marine Corps and the American tax payer.

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ENDNOTES

[1]   Jerry R. Morgan, e-mail to the author, 20 September 2006.

[2]   The Sequential Self-Selecting Auction Mechanism (S^{3}AM), was created by Professor Peter J. Coughlan and William R. Gates. The author has been granted permission to utilize their S^{3}AM concept for this thesis.

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[5]   Charles Moskos, "What Ails the All-Volunteer Force: An Institutional Perspective," Parameters; Summer 2001, 4.

[6]   John T. Warner and Beth J. Asch, "The Record and Prospects of the All-Volunteer Military in the United States," The Journal of Economic Perspectives; Spring 2001, Volume 15, No. 2., 179.

[7]   Ibid., 170-171.

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[9]   Ibid., 180.

[10]   Moskos, 7.

[11]   United States Marine Corps, Marine Corps Order 7220.24M: Selective Reenlistment Program (Washington DC: Headquarters United States Marine Corps, 1990), 1-2.

[12]   Ibid., 4.

[13]   Ibid., 4.

[14]   Ibid., 5.

[15]   Jerry R. Morgan; Major, United States Marine Corps,

   Power Point presentation e-mailed to the author, 17
   October 2006, 6.

[16]   Ibid., 6.

[17]   Ibid.

[18]   Ibid.

[19]   Ibid., 11.

[20]   Ibid., 8.

[21]   Ibid.

[22]   Ibid.

[23]   Ibid., 9.

[24]   United States Marine Corps, <u>Marine Corps Order
   7220.24M: Selective Reenlistment Program</u> (Washington
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   Economics of Information, Second Edition</u> (New York:
   Cambridge University Press, 2006), 350.

[30]   Preston R. McAfee and John McMillan, "Auctions and
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   Volume 25, No. 2., 702.

[31] Paul Milgrom, "Auctions and Bidding: A Primer," Journal of Economic Perspectives; Summer 1989, Volume 3, No. 3., 3-4.

[32] McAfee and McMillan, 702.

[33] Ibid., 702.

[34] Campbell, 335.

[35] Ibid., 335.

[36] William R. Gates and Peter J. Coughlan, "Separation Pay Options," Power Point presentation e-mailed to the author, 18 May 2007, 1-9.

[37] Ibid., 2.

[38] Gregory N. Mankiw, Principles of Economics, Third Edition (Mason: Thomson South-Western Press, 2004) 480.

[39] Ibid., 480.

[40] Ibid.

[41] Ibid., 481.

[42] Ibid., 482.

[43] Ibid.

[44] Ibid.

[45] Ibid., 484.

[46] The Nobel Prize. Org, "List of all Nobel Laureates," http://nobelprize.org/nobel_prizes/economics/laureates/1996/press.html. Last Accessed June 2007.

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[49] Ibid., 15.

[50] Ibid., 16.

[51] Ibid., 20.

[52] Milgrom, 4.

[53] Ibid., 4.

[54] Ibid., 7.

[55] Ibid., 10.

[56] Ibid., 11.

[57] McAfee and McMillan, 706.

[58] Ibid., 707.

[59] Ibid., 712.

[60] Ibid., 713.

[61] David Lucking-Reiley, "Using Field Experiments to Test Equivalence between Auction Formats: Magic on the Internet," The American Economic Review; December 1999, Volume 89, No. 5., 1066.

[62] Ibid., 1068.

[63] Ibid., 1069.

[64] Ibid., 1072.

[65] Ibid.

[66] Ibid., 1078.

[67] Gerard J. van den Berg, Jan C. van Ours, and Menno P. Pradhan, "The Declining Price Anomaly in Dutch Rose Auctions," The American Economic Review; September 2001, Volume 81, No. 4., 1056.

[68]   Ibid., 1056.

[69]   Ibid., 1059.

[70]   Ibid., 1059.

[71]   Campbell, 326.

[72]   William R. Gates, "Innovations in Retention Bonuses,"
Power Point presentation e-mailed to the author, 2 May
2007, 14-15.

[73]   Ibid.

[74]   Ibid., 16.

[75]   Ibid.

[76]   Ibid.

[77]   Ibid.

[78]   It is possible for one or even a handful of reenlisted
Marines to be paid the exact amount of their bid, but
only if they happened to submit the exact same bid as
the first excluded bid (in other words, only if they
were "borderline" winners of the auction).

[79]   Robert L. Anderson, "The Potential Impact of an Auction
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Obligation," (Monterey: Naval Postgraduate School,
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[80]   Peter J. Coughlan, e-mail to the author, 27 January
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[81]   Ibid.

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Kimble, and Aline O. Quester, "Cost-Benefit Analysis
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[87] United States Marine Corps, Marine Corps Administrative Message: FTAP Mission (Washington DC: Headquarters United States Marine Corps, 2005), 1.

[88] Jerry R. Morgan, e-mail to the author, 29 May 2007.

[89] Ibid.

[90] United States Marine Corps, 1.

[91] Jerry R. Morgan, e-mail to the author, 29 May 2007.

[92] Ibid.

[93] Ibid.

[94] Ibid.

[95] Ibid.

[96] Clearly, the 2/6 year contract potential savings depicted in this row are much larger than the potential savings delineated in the previous 2/6 year contract row. This is the case, because the S^3AM was computed using the actual number of FY06 SRBs that were paid to the 0311s, 0621s, and 5811s that reenlisted under the FTAP. Respectively, the actual number of Marines that were paid an SRB are the following: 482 (0311s), 200 (0621s), and 95 (5811s). These numbers were provided to the author by Major Jerry R. Morgan, the Marine Corps' Enlisted Career Force Planner. Please refer to the "Key Points and Assumptions" section of Chapter IV for the rationale behind the potential savings calculations (p. 41).

[97] Jerry R. Morgan, e-mail to the author, 18 April 2007.

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